Fifth Report of the Joint Standing Committee on Safety in the Use of Power Presses

TO H.M. CHIEF INSPECTOR OF FACTORIES

Sir,

The Committee appointed in 1940 by H.M. Chief Inspector of Factories to examine the problem of Power Press Safety published its Report in 1945. The Report contained amongst other matters a series of recommendations for the future design and safeguarding of power presses.

The Committee also recommended the setting up of a Joint Standing Committee to review progress and to make further recommendations from time to time. A Committee was duly appointed and in four reports to date has made a number of recommendations modifying or extending the original ones.

We, the present members, feel that the time has now come to codify these matters into one document, at the same time incorporating any amendments or additions found to be necessary. This, our Fifth Report of Proceedings, has been prepared with this object in view and we recommend that it be published. It is composed wholly of such a codification, entitled "Power Press Safety Code", which specifies requirements for power press design and for tool safeguarding. We would not wish to stand in the way of further development and it will be our intention to keep the Code under review.

Although this Code is not intended to interpret the provisions of the Factories Act relating to the secure fencing of dangerous parts of machinery, we believe that its adoption will result in a substantial improvement in the standards of safety at these machines.

The methods of tool safeguarding described in this Code are not exclusive. Fixed guards, when in position, have the obvious merit of completely preventing access to the trapping area, always providing that their design and construction is effective; their importance in the scheme of safeguarding must be recognised. We would emphasise, however, that presses should be so designed as to allow the safe application of the types of safeguard specified in this Code even though fixed guards may be appropriate for particular tools.

In so far as the Code deals with press design, its requirements are restricted to those which we regard as having a bearing on the safety of workpeople when working at the tools of the machines. It does not deal with the fencing of those parts of the machinery which are common to machinery in general, such as driving parts, nor to the special obligations placed upon those who sell machinery or let it on hire to safeguard certain specific parts. Furthermore the Code does not concern itself with two important "user functions", namely the safe design of press tools and safe techniques for tool setting, both of which subjects have been studied by the Technical Sub-Committee on tool setting and tool design. Draft reports have been prepared and we hope to make recommendations on these subjects in the near future.

We wish to draw particular attention to paragraphs 73(*b*)(i) and 74(*b*) of the Code. Our intention here is to stress that one of the functions of the guard-control should be to keep the shutter closed if, following an intended stroke, there is continued rotation of the crankshaft, however caused.

This report should be carefully studied and the Code adopted by all those concerned with the design, sale, purchase and use of power presses. We feel that by so doing a further contribution will be made to the continuing efforts necessary to reduce the number of accidents which have for so long been a deplorable feature in the use of these machines.

(*Signed*) H. WOODS (*Chairman*)
W. H. L. BROGDEN
H. D. CHALLEN
N. ELLIOTT
R. K. MAWSON
JOHN R. MOORE
A. L. STUCHBERY
J. D. UDAL
J. HIRD (*Secretary*)

General

Certificate of Soundness

1. In the case of a new power press which has not been previously used, a certificate should be issued by the maker certifying that the machine on completion was in sound condition and in effective running order.

Mark of Identity

2. Each press and the guard or safety device used in connection with it should be distinctly marked so as to enable the corresponding records of examinations and tests to be readily identified.

Flywheel Speed

3. Every press should be marked with the maximum speed of the flywheel as certified by the maker. The direction of rotation of the flywheel should be clearly indicated.

Crankshaft Stopping Position

4. Every press should be marked with the correct stopping position of the crankshaft.

Facilities for Fitting Guards

5. (*a*) Press construction should be such as to facilitate the provision of guards enclosing the whole area of the table.

(*b*) Adequate and appropriately situated machined surfaces should be provided to permit accurate fitting of guards and guard mechanisms.

(*c*) Adequate provision should be made for the fitting of a control disc and, in the case of End Wheel Presses, such provision should be made, if possible, between the bearings.

(*d*) On motorised geared presses the driving belts and the primary driving wheel should not obstruct the provision of a control disc associated with an interlocking safety device, where such a disc is required.

Pedals

6. Operating pedals, handles and associated linkages should be adequately screened or otherwise arranged so as to prevent operation by objects falling on or coming into contact with them. Pedals should not be of width greater than that required for operation by the foot.

Balancing

7. Balancing of the slide or slides, together with the tools and accessories attached thereto, is a contribution to steady running, and provides for greater stability at or near top dead centre under static conditions. There should be

sufficient counter-balance to provide for the heaviest tools and attachments to be used on the press. Where automatic guards are used, balancing is advantageous when it is necessary to prevent an accelerated fall of the slide in the event of over-run. Where balancing arrangements are dependent on compressed air, either a receiver of adequate size should be provided at the press to act as a surge tank and to ensure the maintenance of a sufficient supply of air for the operation of the machine, or balance cylinders should be of such a size as to provide an adequate unswept volume. It is understood that an appropriate practice is for the surge tank or unswept volume of a balance cylinder to be five times that of the swept volume of a balance cylinder. Valves should not be interposed between surge tanks and balance cylinders. The air inlet to balance cylinders should be so situated as to prevent accumulation of liquids in the vessels.

When a press is balanced by air, suitable means should be provided for preventing operation if the pressure falls below a safe limit.

Arrestor Brakes

8. The purpose of an arrestor brake is to provide a means whereby a full power stroke can be prevented. It is of particular value in preventing a repeat or uncovenanted stroke arising from failure of the clutch to disengage through mechanical fault or through seizure of the flywheel on its journal.

It is regarded as a necessity where a press is fitted with an interlocking guard which opens before the crank has reached its normal stopping position, unless other means is provided in the guard to ensure that the operator will not be exposed to risk during an immediately following repeat stroke.

Definition

9. An arrestor brake is a device, attached to or incorporated in a power press, which is capable of bringing to rest the moving parts of the press within the limits specified below. In the light of current experience, this device is understood to be an arrangement which arrests the whole of the moving system by absorption of energy during a small proportion of slide movement.

Specification of Performance

10. (*a*) When a guard operates in conjunction with an arrestor device the arrangements should be such that the arrestor device will be in an effective condition to operate at all times other than when the guard is closed and preventing access to the danger area.

(*b*) The arrestor device should ensure that when operated at a speed not exceeding that at which the test required by 10(*f*) below is carried out, the slide or slides should be brought to rest within a distance from the top of the stroke of not more than 10 per cent of the stroke, or ¾ in., whichever is the lesser.

(*c*) The arrestor device should be so constructed and applied to, or incorporated in, the press as to ensure that it will absorb and dissipate all the energy of the moving parts of the press, including the driving motor, without resultant material damage to itself or to any part of the press.

(*d*) The device should be so arranged that, after it has operated, it must be restored to its initial condition before the press can be operated again.

(*e*) Precautions should be taken to ensure that friction surfaces cannot be impaired by intrusion of oil or grease.

(*f*) Each arrestor device should be subjected to a performance test under load by the maker, and a certificate of the test, stating the speed at which the test was carried out, should be supplied to the occupier. If subsequently the speed of the machine is increased, a further test should be made and certificate supplied.

(*g*) Every press fitted with an arrestor device should be provided with a suitable means to prevent fall-back of the crankshaft.

Conditions of Use

11. (*a*) It is the occupier's duty to test and maintain the arrestor device in accordance with the maker's recommendations.

(*b*) A press fitted with an arrestor device should not be run at a speed exceeding that specified in the last certificate furnished in accordance with 10(*f*) above.

(*c*) The operation of an arrestor device is evidence of a fault in the mechanism of the press. In such a circumstance, the press should not be run again until a full investigation of the occurrence has been made and appropriate remedies applied. Where operation takes place, e.g. by the clutch remaining in engagement, or by flywheel seizure, a report of the investigation should be recorded and kept available for submission to H.M. District Inspector of Factories.

Electrical Equipment and Control for Clutches

Electrical Supply for Control Circuits

12. Control circuits should be operated at a voltage not in excess of 120, except in the instance of a single electrical component in a single circuit, both completely insulated.

13. It is recommended for any transformer that either (*a*) the secondary should be earthed on one pole and fused on the other pole, and that the earthed pole should form the common connection for all contactor coils; or alternatively, (*b*) the secondary winding should have an earthed centre tap with earth leakage protection in the control circuit.

14. To avoid the possibility of sneak circuits occurring through tracking across insulated contacts in control switches, push-buttons etc., it is further recommended that all such switches should have their contacts separately mounted and insulated from earthed metal enclosures.

15. All wiring to switches, push-buttons and other apparatus should be terminated by means of effective electrical connections. The making of a connection by twisted wire around a terminal screw is not regarded as an effective method. Electrical components should be removable without disturbing the cable or

wiring in a manner likely to damage it. Attention is drawn to the British Standard 2771/1956, Electrical Equipment of Machine Tools, which should be generally adopted and applied.

16. The press driving motor should either be at rest or up to full speed before there is any response to the "Run" clutch control(s). (See also para. 53.) Where a reversing switch is provided, this should not operate except where the press driving motor is at or near rest.

Selector Switches

17. Where alternative methods of operation of the press are provided, e.g. Single-Stroke, Inch, or Continuous; Front, Back, or Front-and-Back, a selector switch or switches should be provided, so designed that it/they can be definitely located in each position, so as to prevent accidental displacement.

The switch design should be such as to ensure that the circuit becomes completely isolated during movement of the switch from any one position to any other.

Operators' Controls (Control Buttons)

18. The requirements given below for control buttons apply to hand-operated button type switches for operating a clutch control circuit.

STOP BUTTONS

19. Stop buttons should conform to the following requirements:

(*a*) The part operated by the hand should project clear of the housing, e.g. be of the mushroom or palm type.

(*b*) The surface operated by the hand should be not less than 1¾ in. in diameter and should be coloured red.

(*c*) They should be so designed and located that, as far as practicable, they cannot be inadvertently jammed or otherwise prevented from being freely operated.

(*d*) There should be one or more stop buttons per operating station as a minimum, i.e. where there is a start button there should be a stop button. In addition, where there is access at the back of a press, a stop button should be provided even though no operator works there.

(*e*) Stop buttons may be of the type which locks the circuit in the open condition after operation.

(*f*) A stop button, after operation, should not restart the cycle when released or reset.

OPERATING BUTTONS

20. This clause is intended to apply both to Run and Inch buttons except where the contrary is indicated. Operating buttons should conform to the following requirements:

(*a*) They should be so designed and located that they cannot be wedged or otherwise held in an unauthorised manner in the operating position.

(*b*) Where more than one operating (Run) button is provided, there should be proper means for "locking-in" but such arrangements should be such as to ensure that all the buttons cannot be locked-in at the same time.

This requirement may be met for example by appropriate systems of selection or by arranging that one button is of a kind which cannot be locked-in. It is particularly important that buttons should be so designed that they may not be inadvertently locked-in by mechanical failure.

Locking-in. Locking-in is understood to mean that an operating button is, for the time being, a permanent link in the control circuit.

(*c*) Suitable fixed protective shrouding or guarding should be fitted to prevent accidental operation.

(*d*) Where operators' buttons are mounted on portable pedestals, particular care should be taken to ensure stability and also to provide effective shrouding to prevent accidental operation. INCH buttons should not be installed on portable pedestals or other adjustable mountings.

GENERAL POINTS OF DESIGN OF BUTTON SWITCHES

21. (*a*) Buttons should be so spaced that their centre points are at least 4 in. apart.

(*b*) The function of each button should be clearly indicated.

(*c*) The arrangement of control buttons should be in a standard order. A vertical arrangement is preferred with the stop button at the bottom and the RUN button at the top.

(*d*) Buttons should be so constructed that excessive pressure on the operated part cannot be transmitted to the interior mechanism.

(*e*) All external parts should be constructed of materials which will not be shattered by a sharp blow.

Solenoids

22. Solenoid operated valves should be arranged to operate in such a direction as to impose no undue frictional resistance on the solenoid plunger.

23. Solenoids should be so enclosed as to prevent the ingress of dust or other foreign bodies in quantity and nature sufficient to interfere with the efficient working of the apparatus.

24. Means should be provided to permit manual operation of the valve if necessary for test purposes without removal of the cover of the solenoid.

25. Wherever practicable provision should be made for a sensing device to monitor the correct operation of the valve, especially the return of the valve to its "off" position.

Slide Adjustment Motors

26. Provision should be made to ensure that a slide adjustment motor cannot be set in motion while the clutch control circuit is energised.

Limit Switches

27. Switches intended to terminate a cycle should be opened positively by cam or other appropriate mechanical action.

28. The mechanical arrangements for operating limit switches should be such that the roller and cam or other device is adequately proportioned and made of appropriate material to withstand wear which might lead to ineffective

actuation of the limit switch. Steps should be taken to ensure that the means of operation of the switch, and the switch itself, are maintained in their correct relationship.

29. Where it is considered that operating levers and/or rollers which are incorporated in limit switches are not adequate for cyclical working, separate mechanical linkages should be provided.

30. Limit switches should preferably be so designed that the action of finally opening the contacts should be mechanically positive in order to ensure reliability. The electrical contacts should be of liberal rating so as to provide adequate safeguard against fusion.

31. Electrical conductors should be sufficiently rigid, supported and spaced so that short circuit will not occur by arc-over and should be so insulated as to prevent "tracking" due to creepage.

32. The switch should be so designed as to prevent ingress of dirt, moisture, dust, fumes, oil or other foreign material of an extent likely to interfere with the proper working of the switch and should be so mounted as to withstand vibration which might interfere with its proper working.

33. Limit switches should be designed with a liberal degree of over-travel.

34. If a limit switch is operated by a cam, the cam should be so designed that reverse rotation will not damage the limit switch.

Special Points to be Observed in Connection with the Use of Electrical Equipment Associated with Guarding Systems

35. Where a guarding system is associated with the use of electrical equipment, the guard-operated switch (or switches) is termed the interlock switch and the circuit so controlled is referred to as the interlock circuit. The safe condition should be that of the interlock switch being open and the interlock circuit being de-energised.

36. Particular care must be taken in the design and construction of the interlock circuit and all components to prevent the possibility of faults which would have the same effect as the closing of the interlock switch. Points for consideration in this connection are layout, wiring, insulation resistance, choice of materials, prevention of failure from tracking and provision of adequate creepage distance. The apparatus should be sufficiently protected against ingress of oil, moisture etc., as to ensure that the apparatus should not be prevented from working safely and satisfactorily.

37. The interlock and control circuits should be so designed and constructed as to prevent the formation of any transient over-voltages due to the action of inductive and/or capacitive circuit elements (e.g. contactor coils, power factor capacitors, spark quenching capacitors) such as might impair the operation of the circuits.

38. Interlock and clutch control circuits should be independent of any circuit in which there might be back E.M.Fs. which could delay the opening of the contactors; and there should be no circuit elements, or components such as power factor correction condensers, which might likewise delay the prompt action of any interlock and control circuit switchgear.

39. Particular care should be taken to ensure that the correct and prompt action of any safety device is not disturbed as the result of the fitting of radio interference suppression devices, either at the time of manufacture or subsequently. To this end, competent advice should be obtained.

40. Interlock and clutch control circuits should be screened and/or separated if the circuits are of such a type that false operation or damage could result from electrical pick-up, e.g. from high frequency equipment.

Presses with Positive Clutches

Single Stroke Devices

41. Each press should be fitted with an effective single stroke attachment but this requirement should not prevent the provision of arrangements for continuous stroking.

Clutch

42. (*a*) The clutch should be so arranged that when the key is disengaged the driving part thereof should not be in rubbing contact with the flywheel or flywheel bush.

(*b*) Arrangements should be made for the effective lubrication of the flywheel bearing in order to prevent seizure of the flywheel upon the journal.

Prevention of Over-run and Fall-back

43. Effective means, in addition to and independent of the normal cyclical working of the friction brake on the press, should be provided to prevent involuntary descent of the ram and/or any other slide, either by over-run or fall-back of the crankshaft, or by gravity fall of the ram where this is not directly connected to the crankshaft (as in the sliding-block clutch machine).

The expression "over-run" means movement of the crankshaft with the clutch disengaged beyond the position at which the crankshaft normally comes to rest.

Extractor Design

44. The "extractor" (also known as the "latch") is the device which by direct contact causes the disengagement of the clutch key or other intermittent positive driving unit.

(*a*) The extractor should be so designed that after being moved to the position where the clutch is released for engagement, it cannot return to the clutch disengaging position until the crankshaft has rotated at least 15° from its normal stopping position.

(*b*) Where an extractor embodies a recoil cushioning or recuperating device which is used to return the extractor to its normal extracting position before re-engagement of the clutch, means should be provided to ensure that, in the event of the extractor failing to recover this position, the extractor will be locked to prevent a further engagement of the clutch.

(*c*) The extractor should be prevented by suitable stops from moving beyond the designed limits necessary for release and disengagement of the clutch. The stops should be in direct contact with the extractor, i.e. with the part which makes direct contact with the clutch key and not with any associated links or connections. Wherever possible the stops should form part of the bracket, casting or other part of the press in which the extractor is mounted.

(*d*) The design of the extractor should be such as to permit of efficient interlocking with a safety device.

A particular object is to ensure that the movement of the interlocking device should bear a reasonable mechanical relationship to the movement of the associated guard when it passes from the open to the closed position. It is considered that such a reasonable relationship will be achieved if the interlocking member at the extractor has a movement of at least two inches between its limits of travel. In the case of rolling key and other positive clutches employing recoil equipment, indirect interlocking will generally be required in order to achieve the requisite reasonable relationship between the interlocking arrangement and the guard screen.

(*e*) Surfaces intended to form part of an interlocking arrangement should be of adequate proportions and be of suitable wear-resisting quality material.

(*f*) The range of movement of the extractor should be adequate to secure the provision of an effective interlock. When the extractor is in the locked (clutch disengaged) position, any free movement of the extractor against the interlock should not exceed 15 per cent of the travel required to release the clutch. Where, however, a radial key clutch having a ring or "banjo" type extractor with a secondary movement or travel which takes place at some point in the upstroke of the press is associated with an arrestor brake and an interlocking guard intended to open early in the upstroke, the free movement of 15 per cent may, in this special case, be exceeded by the amount of secondary movement or travel. The whole purpose of the secondary movement, which can take place only after the key has been fully disengaged, is to hold the key disengaged at all positions of the crankshaft.

(*g*) Suitable faces to give back-up support for the interlocking members of the guard mechanism should be provided so as to prevent distortion of the members when subjected to load by the extractor.

(*h*) Where an extractor embodies a recoil, cushioning or recuperating device, means should be provided to ensure that, when the extractor is in the position where it allows the clutch to engage, it should not be possible to compress the recoil device by pressure derived from the interlock guard.

Extractor Interlocking

45. The extractor or latch should be fitted with a positive interlocking device, whether forming part of the press or the guard, to fulfil the following conditions:

(*a*) The interlocking device should be capable of locking the extractor in the position which it takes up when holding the clutch out of engagement.

(*b*) When the extractor is in any position other than that specified in (*a*), it should not be possible to move the interlocking device.

(*c*) The interlocking device should be designed so that in its free condition, that is when it is not constrained by attachment of a guard or by locking it in position so that the extractor is free to move, it takes up the position in which it locks the extractor as described in (*a*) through the action of gravity or by a string incorporated in the device.

(*d*) Paragraph 41(*e*) should apply equally to the interlocking device.

Presses with Friction Clutches

Clutch and Brake Design

46. Clutches and brakes should be of such capacity as to perform satisfactorily when engaged and disengaged momentarily each time the correct stopping position is reached, under conditions of maximum sustained production.

47. The design should provide for adequate dispersal of heat so as to prevent excessive temperature rise of the working parts.

48. Sufficient working clearances should be provided so as to ensure that under the severest conditions of operation, friction drag leading to undesired movement of the driven members will not take place.

49. Arrangements should be made to prevent the accumulation of debris evolved from frictional surfaces, in places where it might give rise to clutch drag or seizure, and for its effective dispersal.

50. All practicable steps should be taken to avoid the possibility of corrosion. This applies particularly to air cylinder surfaces.

51. Effective means of lubrication of bearing surfaces should be provided, or such other treatment given, as will minimise the chance of scuffing or seizure. Particular attention should be given to the means of lubrication of the continuously rotating member, and the point of application of the lubricant should be readily accessible.

52. Consistent with other mechanical considerations, the stage between brake release and clutch engagement, and between clutch disengagement and brake application, should be as small as possible in dimension and in time.

53. Where springs are used for applying the brake and withdrawing the clutch, these should be safely rated and be sufficient in power to secure prompt clutch withdrawal and effective brake application. Care should be taken to ensure that all the springs are closely uniform in dimension, quality and rating. A single spring should not be relied upon for this duty, unless equivalent safety is assured by other means.

The means for loading the springs should be such that, when appropriately adjusted, the spring anchorages can be locked to prevent risk of slacking back.

The arrangements for spring housing and guiding, and of guide pins, should be such as to minimise the risk of binding.

54. Where a clutch and brake system is operated by a diaphragm, special care should be taken to avoid damage to the diaphragm, e.g. by the cutting effect of sharp edges.

55. When the presence of oil on brake friction surfaces would adversely affect the performance of the brake, effective arrangements should be made to prevent penetration of the oil to brake surfaces.

Control of Driving Motor

56. Arrangements should be incorporated which will ensure that after switching off a driving motor, this cannot be restarted unless the clutch is disengaged.

57. A flywheel brake should be provided which can be applied when the motor is switched off. The brake should be capable of arresting the continuously revolving parts in not more than (approximately) 60 seconds. Arrangements should be further incorporated which will ensure that, upon application of the brake, the driving motor cannot be restarted unless the clutch is disengaged.

This is not applicable, however, to presses where the crank or eccentric is moved by hand for tool-setting purposes.

Compressed Air Supply for Clutch Operation

58. Every press should bear a prominent plate stating the minimum designed working pressure for operation of the clutch.

59. There should be provided a supply of compressed air at each press, adequate in quantity and of sufficient pressure to enable the press to be operated at the minimum designed pressure. A pressure gauge should be fitted in the supply line. Arrangements should be provided to ensure that, if pressure falls below the minimum designed pressure specified by the maker, it will not be possible to operate the machine until the pressure has been restored to the minimum designed pressure.

60. In the supply pipe to each press there should be fitted a strainer or other device capable of effectively removing moisture from the air, and solid foreign matter such as corrosion scale. Appropriate means should be provided for draining off water collected by the straining device and for the removal of solid foreign matter. There should be a suitable drain trap in an appropriate position. Any piping situated beyond the point where moisture and solid foreign matter are removed should be made of a material which is not subject to corrosion.

61. Where valves or other working parts of the press control system require lubrication, visual automatic means of lubrication should be provided to introduce the oil into the air line in suitable form. The arrangements should be of such a nature that they will only operate when air is flowing. The lubricator, and the equipment referred to in paragraph 57, should be placed as close as possible to the main clutch control valve, but should be readily accessible and visible.

62. All piping, piping fittings, passages, surge or storage tanks, and cored holes or drilled holes, should be free from burrs or foreign matter which might cause damage to valves or clutch operating parts. Sharp edges should be removed wherever they may adversely affect the flow of air.

63. Each run of piping should be continuous from one piece of apparatus to another. Equipment or components should be removable without disturbing the piping runs and without bending or springing the piping in a manner likely to damage it. Rigid piping should be securely supported at frequent intervals to avoid vibration or movement.

Air Control Equipment

64. Operating valves should not depend for support on connected piping. (The object of this is to avoid undesirable effects from vibration which might affect both valves and piping.)

65. Operating valves should be so designed as to ensure that, when in the idling or non-operating position, leakage of air past the inlet valve will escape to atmosphere sufficiently freely to prevent build-up of pressure in the clutch operating cylinder.

66. Operating valves should be so designed that it is not possible for both the inlet port and the exhaust port to remain closed at the same time.

67. Exhaust ports and piping between clutch operating cylinders and valves should be of sufficient capacity to ensure prompt release of air from clutch operating cylinders.

68. Control valves should be mounted in positions which provide complete accessibility without interfering with adjacent equipment.

69. Control valves should be so designed, placed or enclosed as to prevent intrusion of foreign bodies or exposure to inadvertent jamming.

70. Where valves are manually or mechanically operated (as distinct from electrical means) the arrangements for restoring the valves to the position of clutch disengagement at the end of the cycle should be positive in character.

71. Where valves are operated by pilot systems, it is recommended that arrangements should be adopted which ensure immediate release of air pressure from the clutch and brake mechanism in the event of failure or partial failure of the pilot system.

Emergency Anti-Repeat Device

72. Each Press should be fitted with an emergency anti-repeat device, whose function is to prevent the machine from making a repeat stroke arising from faulty operation of the control equipment. This control equipment is taken to include all equipment, however operated, which is concerned with the cyclical operation of the press. The arrangement should preferably be mechanical in character and an example of such a device is illustrated in Annexe 2 of the Fourth Report of Proceedings of the Joint Standing Committee on Safety in the Use of Power Presses. In some instances the provision of a completely mechanical arrangement may be difficult, and electrical arrangements may be necessary. In this connection attention is drawn to the device described in Appendices 6 (page 15) and 8 (page 23) of the Fourth Report of Proceedings of the Joint Standing Committee. An arrestor brake may be regarded as a device complying with the recommendations of this paragraph.

The purpose of this clause is to ensure that a standard of safety equal to that specified above for presses with positive clutches will in all cases be achieved by the means most appropriate to the function and construction of the press.

Guard Construction and Performance

Interlocking Guards

PRESSES WITH POSITIVE CLUTCHES

73. (*a*) *Guard structure*

The general standard for the interlocking guard is that it should have a feed opening capable of being closed by a movable shutter, the shutter being arranged so that in its fully closed position it overlaps the fixed framework of the feed opening by an amount not less than 10 per cent of the shutter movement (see (*g*) below); the guard to be a permanent part of the press equipment. The shutter should be connected positively to the interlocking device referred to in paragraph 42, and this connection should be made in such a way that, for all positions of the shutter other than when it is closed and preventing access to the tool and die of the press, the extractor will be locked in the position of clutch disengagement. The design should allow the guard to be moved out of position for tool setting and when enclosed tools or tools equipped with fixed guards (which types of safeguard are often the best) are to be used; and should provide that the guard is so constructed that it remains attached to the press structure by means of its fixings during operations for tool setting or whenever it is not in use as a guard. The moving of the guard from its effective position should so control the extractor that the press cannot be set in motion until an adjustment has been made. If the design of the press allows working from more than one side, arrangements should be provided for the fitting of a guard giving the same standard of protection on each side as is specified in this paragraph.

(*b*) *Guard control*

(i) Effective independent means should be provided which will ensure that, when the clutch is in engagement whether by intention or otherwise, it will not be possible to open the shutter of the guard.

(ii) The arrangements should be such that it will not be possible to develop pressure on the extractor through the locking device, or through the shutter connected to the locking device, so as to prevent the movement of the extractor to the position which it takes up when holding the clutch out of engagement.

(iii) An arrestor brake as defined in paragraph 8, if fitted and connected to the guard and being effective for this purpose, shall be deemed to be an appropriate alternative to the requirements of sub-paras. (i) and (ii).

(*c*) *Auxiliary guards*

Fixed side and, where necessary, back guards should be provided which, in conjunction with the guards specified in (*a*) above, should prevent access to the trapping area except through the feed opening; these guards should be so mounted that they remain attached to the press.

(*d*) *Variable stroke*

On variable stroke presses, stroke variation should not affect the performance of the guard and associated interlocking arrangements.

(*e*) *Failure to safety*

Interlock guards should be so designed and constructed that in the event of interruption of the connections between the guards and the interlocking mechanism, the clutch will be automatically locked to prevent engagement until the connections have been made good. On inclinable presses this result must be achieved for all positions of the press body.

(*f*) *Toolsetter disconnection*

Any disconnecting device should be so designed and constructed that no part thereof can be detached from the guard mechanism, and should require a tool or key to disconnect it.

(*g*) *Overlap*

The reference to the overlapping of the fixed framework by the shutter in (*a*) above should be interpreted as follows:

> The gate or shutter of the guard should be so arranged that movement of the clutch extractor for clutch engagement will not be possible until the gate or shutter has moved to a position beyond the "in-line" closed position by an amount equal to at least 10 per cent of its total movement. It is recommended that, whenever reasonably practicable, this overlap should be greater than 10 per cent. The design of the guard should be such that there will be no possibility of re-exposure of the danger area whilst the guard is traversing the overlap zone.

(*h*) *Sequential operation*

Sequential operation means a method of operation whereby engagement of the clutch follows automatically upon the closure of the guard by the operator. Sequential operation is generally achieved by the use of compressed air, though electrical methods or mechanical methods are possible. It may follow closure of the guard by hand, by foot or by power.

In all applications the following points should be observed:

(i) The guard should embody effective means of interlocking and must be so arranged that removal or failure of the sequential operating feature will not impair the effectiveness of the guard as a safety device.

(ii) The situation of the clutch operating valve or switch should be such that its actuation is achieved by the moving guard screen and is so arranged that it does not operate until the screen is in the position of secure fencing.

(iii) The arrangements should be such that examination and testing of the interlocking devices can be effectively carried out. The independent testing of the interlocking devices will generally involve some disconnection of the guard and press operating mechanism.

(iv) Where compressed air is used as an operating medium, build-up of pressure in supply pipes between control valves and operating cylinder(s) should be prevented by free openings to atmosphere except when valves are actuated to admit air for operating purposes.

PRESSES WITH NON-POSITIVE CLUTCHES

74. The general standard for an interlocking guard should comply with the following requirements:

(*a*) When there is access to the parts where trapping can occur, the press clutch should be prevented from making an engagement.

(*b*) When the press ram is in motion, no access of the fingers to the parts where trapping can occur should be possible.

Requirements (*a*) and (*b*) should be met in the following ways:

(i) Means of interlocking to prevent clutch engagement until the guard is fully closed, and *either*

(ii) Means to ensure that the guard cannot be opened (1) while the clutch is in engagement, and (2) until all possibility of continued further movement by reason of brake failure or, of re-engagement of the clutch is passed, *or*

(iii) Means to ensure that, whenever the guard is open, the crankshaft and suspended gear is prevented from making a movement sufficient to cause danger, irrespective of the causation of such movement.

(*c*) As far as the movable part of the interlocking guard is concerned, the same standard of construction and performance should be applied as is required for presses with positive clutches. Exceptionally, in the case of large presses, the requirement that the guard in the closed position should overlap a fixed frame need not be observed provided the guard in its closed position effectively prevents access to the danger area.

(*d*) Fixed side and, where necessary, back guards should be provided which, in conjunction with the interlocked guard and the structure of the press, should prevent access to the trapping area except through the feed opening.

(*e*) On a press with an electrically controlled friction clutch, each interlocking guard should control two limit switches in series, so arranged that the clutch cannot be engaged until every such guard is fully closed. Of the pair of limit switches, one should be so arranged that it is opened by spring action and positively closed by the guard, and the other so that it is closed by spring action and opened positively by the guard. This latter switch should be held positively open for all positions of the guard except when closed. The extent of the guard movement should be effectively controlled.

(*f*) Each such guard should be further controlled by a safety device intended to ensure that the guard will be locked in the closed position as long as air pressure is maintained in the clutch.

75. The guard screen should be so constructed as to prevent when closed, a person from reaching any trapping surfaces. In this connection due consideration must be given to the use of dies up to the full capacity of the press. While each case must be considered on its merits, it is considered that where bed surfaces are less than 18 in. above floor level, the lower edge of the guard when closed should be not more than 18 in. from the floor and further arrangements should be made by decreasing this dimension or by other means where there would otherwise be risk of a person reaching any trapping surfaces. Where by reason of the construction of the press it is necessary for the plane of the guard to be so far away from the slide that a person may be within the guard when closed, the guard should be fitted with a rail or shelf which would, during closing, sweep the space wherein such a person might be.

Automatic Guards

76. Interlocking guards may be used on presses of all sizes and types, but the type of guard described below may be used as an alternative on a press which meets the following specification, whatever the type of clutch fitted:

(*a*) *Press Speed.* For Single-acting Presses, the speed should not be more than the equivalent of 30 strokes per minute, i.e. each single-stroke is to take two seconds or more. On Double-acting and Multiple-acting Presses, the speed should not be more than the equivalent of 15 strokes per minute, i.e. each single stroke is to take four seconds or more.

(*b*) *Length of Press Stroke.* The length of the press stroke should not be adjustable. On Single-acting Presses the stroke should not be less than 8 in. on Double-acting and Multiple acting Presses the stroke should not be less than 6 in. (In the case of Double-acting and Multiple-acting Presses, "stroke" means the stroke of the slide or ram which has the least movement.)

77. The guard should be of a type incorporating an outward and upward moving member, the top of which is never less than 42 in. above the floor or platform on which the operator stands. Access to the trapping area below this member should be effectively prevented at all parts of the press stroke by a suitable screen. This member is positively driven from the press slide or associated mechanism; the drive being designed so that the member attains a safe position before the space between trapping surfaces (including the component at any stage of its entry or withdrawal) is less than two inches or one-fifth of the stroke, whichever is the greater. A safe position is deemed to be within the following range of relative distances:

Distance in inches horizontally from nearest trapping position	—	36	33	28	24	18
Distance in inches vertically above standing place of worker	—	48	54	58	60	63

The construction of the guard should be such that it is not possible for any person to be trapped between the tools, or between the moving guard and any fixed or moving part of the press whether associated with the tools or not.

The design should be such as to give the correct movement of the guard relative to the movement of the press slide, whether the press crankshaft rotates in the normal direction or in reverse.

17 JE 1965

Dd.117403 K14 10/65 (6413)

MINISTRY OF LABOUR

Power Press Safety Code

Fifth Report of Proceedings of the
Joint Standing Committee on
Safety in the Use of Power Presses

LONDON
HER MAJESTY'S STATIONERY OFFICE
1965

CONTENTS

Page
Introduction ix
Letters of Presentation x–1

POWER PRESS SAFETY CODE

Para. Page

General

Certificate of Soundness 1 3
Mark of Identity 2 3
Flywheel Speed 3 3
Crankshaft Stopping Position 4 3
Facilities for Fitting Guards 5 3
Pedals 6 3
Balancing 7 3
Arrestor Brakes 8 4
Definition 9 4
Specification of Performance 10 4
Conditions of Use 11 5

Electrical Equipment and Control for Clutches

Electrical Supply for Control Circuits 12–16 5
Selector Switches 17 6
Operators' Controls (Control Buttons) 18 6
Stop Buttons 19 6
Operating Buttons 20 6
General Points of Design of Button Switches 21 7
Solenoids 22–25 7
Slide Adjustment Motors 26 7
Limit Switches 27–34 7
Special Points to be Observed in Connection with the Use of Electrical Equipment Associated with Guarding Systems . 35–40 8

Para. Page

Presses with Positive Clutches

Single Stroke Devices 41 9
Clutch 42 9
Prevention of Over-run and Fall-back 43 9
Extractor Design 44 9
Extractor Interlocking 45 10

Presses with Friction Clutches

Clutch and Brake Design 46–55 11
Control of Driving Motor 56–57 12
Compressed Air Supply for Clutch Operation . . . 58–63 12
Air Control Equipment 64–71 13
Emergency Anti-Repeat Device 72 13

Guard Construction and Performance

Interlocking Guards 14
Presses with Positive Clutches 73 14
Presses with Non-Positive Clutches 74–75 15
Automatic Guards 76–77 17

MEMBERS OF THE COMMITTEE

H. Woods, Esq., C.B.E., H.M. Deputy Chief Inspector of Factories, Chairman.

W. H. L. Brogden, Esq.

H. D. Challen, Esq.

John R. Moore, Esq.

A. L. Stuchbery, Esq.

J. D. Udal, Esq.

N. Elliott, Esq., M.B.E.
R. K. Mawson, Esq., (Secretary 1946–62) H.M. Factory Inspectorate.
J. Hird, Esq., Secretary

LIST OF FORMER MEMBERS

G. P. (*now Sir George*) Barnett, Esq.	*Chairman*	1946–47
H. A. Hepburn, Esq., C.B.E.	*Chairman*	1947–53
T. W. McCullough, Esq., C.B., O.B.E.	*Chairman*	1953–56
R. Bramley-Harker, Esq.	*Member* *Chairman*	1949–56 1956–59
J. McColl, Esq.	*Chairman*	1959–60
W. F. Evans, Esq.	*Chairman*	1960–63
Sir Atwell Baylay, K.B.B., D.S.O.	*Member*	1946–51
G. W. Clarke, Esq.	*Member*	1946–50
R. K. Christy, Esq.	*Member*	1959
A. B. E. Lovett, Esq.	*Member*	1959–63
H. R. Rogers, Esq.	*Member*	1946–51
F. Southwell, Esq.	*Member*	1946–49

INTRODUCTION

In this Fifth Report of Proceedings of the Joint Standing Committee, recommendations made by the Committee since it was formed in 1946 have been embodied into a Code of requirements for power press design and tool safeguarding, for the attention of those who manufacture, sell, use, or let on hire such presses and/or their safety devices. The object of the Code is to improve standards generally and to stimulate progress.

The Joint Standing Committee owes much to its past and present members, whose names are listed on the facing page, for the assiduous attention they have given to their task, not least to Mr. R. K. Mawson, Secretary from 1946–1962, whose wide experience and technical knowledge have made a great contribution to its work. The thanks of the Joint Standing Committee are due to members of Sub-Committees and to others from home and abroad who, over the years, have put their experience and time at the Committee's disposal. Thanks are also due to the present Secretary, Mr. J. Hird.

To the Rt. Hon. R. J. GUNTER, M.P.
Minister of Labour

Sir,

JOINT STANDING COMMITTEE ON SAFETY IN THE USE OF POWER PRESSES

I have the honour to present to you the Fifth Report of Proceedings of the Joint Standing Committee on Safety in the Use of Power Presses.

The Committee has considered it desirable to codify a number of recommendations made in earlier reports and to bring these up to date, with additional recommendations, in the present Report.

The safe working of a power press depends not only on the fencing provided, but to a very considerable extent on its capacity to function correctly during its entire movements and for these movements to be reliably controlled. A considerable section of this Report is therefore concerned with recommendations about points which should be observed in the design, construction and operation of a power press so as to minimise any abnormality in its functioning which could preclude the effectiveness of safeguards provided. The final sections of the Report deal with matters of importance in relation to interlocked and automatic guards to ensure that they perform as effectively as possible.

The Report contains valuable information which I am sure will be of great assistance to users, designers and makers of power presses and their associated guards and I hope it will be widely read and closely studied.

I am, Sir,
Your obedient Servant,
R. K. CHRISTY,
H.M. Chief Inspector of Factories.